

# APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1991-025

TITLE REMOVAL OF EXPERIMENT TRAIN FROM LONG MODULE AND TRANSFER TO LEVEL IV  
WORKSTAND AREA IN THE O&C BUILDING

DOCUMENT NUMBER/TITLE OMI 15033, EXPERIMENT TRAIN REMOVAL - LONG MODULE

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DATE 20 JULY 1994

## REQUIRED APPROVAL

|            |                                 |                                 |  |  |
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| CONTRACTOR | <input type="checkbox"/> DESIGN | <input type="checkbox"/> R & QA | <input checked="" type="checkbox"/> OPERATIONS | <input checked="" type="checkbox"/> SAFETY |
| NASA       | <input type="checkbox"/> DESIGN | <input type="checkbox"/> R & QA | <input checked="" type="checkbox"/> OPERATIONS | <input checked="" type="checkbox"/> SAFETY |

| TYPE OR PRINT NAME | SIGNATURE                | ORGN.     | DATE    |
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CONTRACTOR DIRECTOR OF SAFETY



**NASA SUSPENDED LOAD OPERATION  
ANALYSIS/APPROVAL**

**NUMBER: SLO-KSC-1991-025  
CHANGE 1, JULY 94  
PAGE 1 OF 5**

**OPERATION** - To remove the experiment train from the long module and transfer the experiment train to the Level IV Workstand area in the Operations and Checkout (O&C) Building.

**SUPPORTING DOCUMENTS** - The associated operational procedure and System Assurance Analysis (SAA) are as follows:

- OMI L5033, Experiment Train Removal - Long Module
- SAA01FS027-002, 27.5 Ton Bridge Crane - O&C

**GENERAL DESCRIPTION** - The task below requires up to eight persons to be under the suspended European Space Agency (ESA) strongback during removal of the experiment train from the long module and transfer to the workstand or storage as follows:

- OMI L5033, Transfer from Workstand Operation

Experiment train removal or transfer operations are performed in the O&C low bay using dual 27.5 ton bridge cranes. The suspended ESA strongback extends out beyond the envelope of the long module, which exposes personnel to a suspended load while attaching or removing the grounding strap, attaching or removing the cable assembly, removing or reinstalling the trunnion safety caps, rotating the roller assembly, removing or stowing the brakes, manipulating or securing the claws, removing or inserting the bolts, nuts, and washers that secure the lower frame to the long trolley.

During contingency payload grounding operations, one person will be permitted to work under the suspended load.

**RATIONALE/ANALYSIS** - The suspended load tasks comply with the NASA Alternate Safety Standard as follows:



**Alternate Standard Requirement #1a** - These operations cannot be conducted without placing personnel beneath the suspended ESA strongback because this particular beam extends out beyond both the long module and the test stand that the payload rests in.

Experiment train and long module operations in the O&C have been evaluated, and it has been determined that there is no alternate access to connect or disconnect the appropriate hardware without passing under the ESA strongback because of its size. As a result, there are no operational or procedural workarounds that can eliminate personnel exposure to a suspended load.

The ESA strongback was specifically designed for module hoisting and requires a dual crane lift. The design of a support structure for this strongback is not feasible because the strongback must be positioned directly over the payload in its holding fixture, which would block access for a strongback support structure.

**Alternate Standard Requirement #1b** - The possible use of a secondary support system, to catch the load in the event of a crane failure, was analyzed. It was determined that the use of a secondary support system was not feasible because of positioning of the experiment train over the test stand.

**Alternate Standard Requirement #1c** - The maximum number of personnel allowed under the suspended ESA strongback during removal of the experiment train from the long module and transfer to the workstand is eight.

**Alternate Standard Requirement #1d** - Experiment train removal or transfer operations will be accomplished as quickly and safely as possible to minimize exposure time. It will take eight persons up to two hours to remove or transfer the experiment train (due to dual crane operations).

**Alternate Standard Requirement #4** - OMI L5033 has been revised to permit only the approved number of persons under the suspended ESA strongback. The OMI is available on site for inspection during the operation.



**Alternate Standard Requirement #6** - Suspended load operations associated with removal of the experiment train from the long module and transfer to the workstand in the O&C involve two 27.5 ton bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The 27.5 ton crane hoists are equipped with two magnetic holding brakes (one on the motor shaft and one on the gear reducer input shaft extension), each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the load (27.5 tons) is verified annually. The cranes are designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components.

Dual 27.5 ton cranes are being utilized. The ESA strongback weighs 15,000 lbs and the payload can weigh as much as 36,520 lbs. The combined load is 51,520 lbs., which is 46.8% of the cranes' capacity.

The lifting slings are rated at 36,520 lbs and are designed to meet a 2.25 to 1 safety factor based on yield strength and a 5 to 1 safety factor based on ultimate strength.

The 27.5 ton cranes are load tested annually at 100% of their rated capacity. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes to ensure proper operation. A detailed inspection of the lifting slings is performed annually. Nondestructive testing of the slings and crane hooks is performed annually.

**Alternate Standard Requirement #7** - A System Assurance Analysis (SAA) has been completed on the 27.5 ton bridge cranes in the O&C. The SAA includes a Failure Modes and Effects Analysis/ Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents).

The SAA identifies one single failure point (SFP), the hoist gear reducer, which transmits power and reduces rotational speed from the hoist motor to the rope drum. A sheared key or broken teeth would cause interruption of the load path at the gearbox. This failure would result in the load dropping, which could cause loss of life and/or payload.

There is no history of failure with the SFP in the critical failure mode. A detailed inspection of the gear reducer is performed monthly, and gear reducer oil samples are verified annually. The use of high-quality, reliable components and a comprehensive



maintenance, inspection, and test program (including preoperational checks) ensures that the crane systems operate properly.

The associated SAA CIL Sheets identify all the rationale for accepting the risk of the SFP including design information, failure history, and the operational controls in effect to minimize the risks (maintenance, inspection, test, etc.).

**Alternate Standard Requirement #8** - Visual inspections for cracks or other signs of damage or anomalies are performed on the hoist hooks, hoist beams, hoist cables, hoist rod assemblies, and hoist fittings, and crane functional checks are performed before each operation per NSS/GO-1740.9.

**Alternate Standard Requirement #9** - Trained and licensed crane operators shall remain at the hoist controls while personnel are under the load.

**Alternate Standard Requirement #10** - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

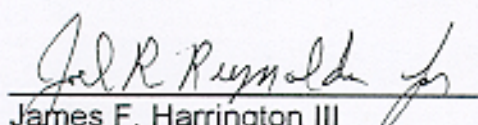
**Alternate Standard Requirement #11** - A pretask briefing and a safety walkdown of the area are conducted prior to the lift to ensure that all systems and personnel are ready to support. All participants are instructed on their specific tasks and warned of any hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of any hazards involved.

**Alternate Standard Requirement #12** - Personnel beneath the suspended load will be in voice contact with the hoist operator and/or task leader. Upon loss of communication, the operation shall stop immediately, personnel shall clear the hazardous area, and the load shall be safed. Operations shall not continue until communications are restored.

**Alternate Standard Requirement #13** - Personnel working beneath the load shall be in continuous sight of the hoist operator and/or task leader.



APPROVAL:      DATE: 8/29/94

  
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